

Cryptomarket forums

SELF-ADVERTISEMENT AND RUMORS ON SILK ROAD

Tinke Klomp (6252923)

BACHELOR THESIS | SUPERVISOR: WOJTEK PRZEPIORKA

Contents

Introduction	2
Theory	3
Data & Methods	6
Results	10
Conclusion & Discussion	13
Literature	16

Introduction

Cryptomarkets are online markets where an exchange of illegal goods and services takes place between actors that use digital encryption to disguise their identity (Martin, 2014). Online markets, in general, have been rising in popularity in recent years and the kinds of goods that are offered on these markets have become broader. Simultaneously, cryptomarkets have become more prominent as well (Morelato et al., 2018). The first cryptomarket that gained a lot of renown was Silk Road, a site that ran from 2011 to 2013 (Christin, 2013). Picking up worldwide media attention following a blog from *Gawker* about the cryptomarket, commotion grew around the dangers expected to come forth from online illicit exchange (Martin, 2014).

The site administrator, Dread Pirate Roberts, pursued the goal to provide some form of order and cooperation without interference from legal authorities, trying to protect sellers and buyers from each other and the state (Zajácz, 2017). Buyers were protected by an escrow service, which is a system where customers bought their products with the cryptocurrency Bitcoin, though the deposit was only released if the buyer was content with the shipment (Aldridge and Décary-Héту, 2014). The intention to guard users from illegitimate transactions, however, was not always guaranteed. Compared to markets where licit products are sold online, cryptomarkets don't have a legal framework that protects buyer from potential misconduct performed by a vendor (Hardy & Norgaard, 2016). Users, moreover, operate with anonymous accounts, which makes it challenging to call on the accountability of sellers (Christin, 2013; Diekmann et al., 2014).

As compensation for the uncertainty that is created with the use of online markets, rating systems are often implemented (Resnick and Zeckhauser, 2002; Jin and Kato, 2006; Sears, 2016). Reputation is able to ensure good behaviour and cooperation between users of online markets (Dellarocas, 2003; Przepiorka, 2013; Jiao et al. 2021). This effect of reputation systems can be found in cryptomarkets as well, as sellers of illegal drugs on Silk Road who receive higher ratings increase their prices and sell more goods, while sellers with lower reputations reduce pricing and are able to sell their items less quickly (Przepiorka et al. 2017).

Another opportunity for buyers to assess the trustworthiness of sellers on Silk Road are the forums of the cryptomarket. Forums enable direct communication between users (Norbutas, 2020). Cryptomarkets can have multiple forums which all serve different purposes (Branwen, 2015). Several examples of these forums are self-advertisement forums, enabling sellers to notify other members of the products they are offering, rumor forums, where sellers, their products and other subjects relating to them can be discussed, and a discussion forum, a platform for members to debate about different subjects and themes, such as privacy, politics

or philosophy (Branwen, 2015; Bancroft and Reid, 2016; Norbutas, 2020). Communication on cryptomarket forums could be positively related to trust between users, as Norbutas (2020) finds that vendors' discussion forum activity increases the number of item sales. In this thesis it will be tested whether the interaction between sellers and buyers on forums weakens the effect of reputation on pricing and sales.

The research question that will be studied in this bachelor thesis is as follows: *To what extent does interaction on cryptomarket forums affect the reputation of the seller, the prices they charge and the speed at which they sell their products?*

This thesis will gain insight into the influence of forums on trust and cooperation between users of cryptomarkets, which is a subject less researched than the effect of reputation and reputation systems. Additionally, the results of this study could be useful to achieve more knowledge of the online illegal drug market, by researching the influence of forums on Silk Road.

In the next section, information asymmetry and the trust problem between sellers and buyers will be set out, as well as the signaling theory. The hypotheses will moreover be presented here. In 'Data & Methods' the data used in the analyses will be described and the manner of using this data will be explained. The descriptive statistics of the variables used will be displayed this section as well. The 'Results' section will set forth the outcome of the regression analyses that are executed to test the hypotheses. The last section will handle the conclusion of the results and the discussion of the thesis overall.

Theory

As mentioned before, the anonymity and environment of Silk Road pose a challenge to assess the trustworthiness of a seller. In an interaction between sellers and buyers information asymmetry occurs (Jiao et al., 2021). Buyers are unable to know the quality of the products offered or the seller's intentions, while the seller does have this information (Raub, 2004). Vendors have an incentive to act opportunistically through not sending items or selling goods of poor quality, since this is more profitable (Norbutas, 2020). This is stimulated by the lack of an institution that attempts to maintain cooperation between buyers and sellers and the ease at which opportunistic sellers are able to change their alias and thereby remain anonymous (Norbutas, 2020).

The high information asymmetry between actors creates a trust dilemma, where the buyer is the first person in the interaction to make a decision, which is to buy a products from a

seller or not (Przepiorka and Berger, 2017; Norbutas, 2020). The second decision is made by the seller regarding the quality of the goods that are sold, how well the package of goods will be disguised and whether the items will be sent at all (Jiao et al. 2021). The buyer tries to make the decision by taking into account the expected outcomes of choosing to buy or not to buy and will only purchase from a seller when the expected payoff of the transaction is higher than when they do not buy goods (Jiao et al. 2021).

An attempt to reduce the risk for buyers to be scammed are escrow systems, which hold the funds of buyers until they finalise the transaction (Martin et al., 2019). Escrow is, as it were, a reproduction of institutional safeguard that can often be found on licit online markets to protect users (Décary-Héту et al. 2016). This should gain back some control for buyers when they initiate a transaction. However, escrow systems are not completely safe themselves. During the ‘Great 430 Heist’ vendor *Tony76* convinced buyers to finalise their order before they received their product, resulting in the theft of 100,000 to 250,000 US dollars (Ormsby, 2014). Additionally, there have been instances where cryptomarket administrators have stolen money through the platform, as buyers funds are held within the escrow service when customers are awaiting their order (Moeller et al., 2017).

To mitigate these risks, customers should be able to recognize the trustworthiness of sellers. To win the trust of buyers, a seller needs to distinguish themselves from an opportunistic seller, by generating a signal that is too valuable for an opportunistic seller to make, but not for a trustworthy seller (Gambetta, 2009; Przepiorka and Berger, 2017; Norbutas, 2020). A seller is able to establish signals anticipating that a buyer will interpret these signals and form an opinion regarding the trustworthiness of the seller, which is an unobservable characteristic of the vendor (Przepiorka and Berger, 2017). For opportunistic sellers a good reputation is too costly, as those kinds of vendors are aiming towards short-term gains and reputation takes time to build and proper reputations take time and effort to build (Przepiorka et al., 2017). The market reputation is the signal that is most evaluated to assess the cooperativeness of a vendor (Diekmann et al., 2014). Since signals of reputation are taken into account by customers, good reputations allow trustworthy sellers to charge premium prices for their goods and sell their products faster (Przepiorka et al, 2017). Aside from the reputation seller receive from the rating system, customers also derive their opinion from signals that are produced on the discussion forums on cryptomarkets (Bancroft and Scott Reid, 2016).

Other cryptomarket forums where signals could be interpreted are the self-advertisement and scammer forums, both present on Silk Road (Branwen, 2015). As sellers are able to

promote their products on the self-advertisement forum (Branwen, 2015), it can be tested whether the signals coming from these advertisements are able to influence the assessment of trustworthiness of sellers by customers. The first and second hypotheses will be as follows:

H1: *If a seller is mentioned by other users on the self-advertisement forum, the price the seller charges for their products increases.*

H2: *If a seller is mentioned by other users on the self-advertisement forum, the number of products the seller sells per day increases.*

The scammer forum is used to discuss sellers, their products and subjects relating to them (Branwen, 2015). It is expected that the signals coming from this forum could have a negative effect on the trustworthiness of a seller, as customers are able to talk about their experience with vendor, which includes wrongdoings and opportunistic behaviour. Therefore, the hypotheses relating to the scammer forum are:

H3: *If a seller is mentioned by other users on the scammer forum, the price the seller charges for their products decreases.*

H4: *If a seller is mentioned by other users on the scammer forum, the number of products the seller sells per day decreases.*

Przepiorka et al. (2017) found that a rating system to distinguish the reputation of a seller has an effect on the prices that are charged and the number of goods sold by the seller. The seller's reputation could be interpreted as a signal of trustworthiness. As signals can be acquired from forums as well, it will be tested in this thesis whether reputation still has an effect on pricing and sales when a seller is mentioned on either the self-advertisement forum or the scammer forum on Silk Road.

H5: *If a seller is mentioned on the self-advertisement forum, the absolute effect of this seller's five-star and non-five-star ratings on prices per gram decreases.*

H6: *If a seller is mentioned on the self-advertisement forum, the absolute effect of this seller's five-star and non-five-star ratings on amount of sales per day decreases.*

H7: *If a seller is mentioned on the scammer forum, the absolute effect of this seller's five-star and non-five-star ratings on prices per gram decreases.*

H8: *If a seller is mentioned on the scammer forum, the absolute effect of this seller's five-star and non-five-star ratings on amount of sales per day decreases.*

Data & Methods

Data

For this thesis datasets are used that contain data on item listings that dealers sold on Silk Road 1.0 and forum conversations that were posted on the cryptomarket. The data on item listings was retrieved by Christin (2013) between 3 February 2012 and 24 July 2012. Data on forums was compiled by Branwen (2015), derived from the data collected by Christin (2013). This thesis takes the research on reputation scores on item price and item sales of Przepiorka, Norbutas and Corten (2017) as a starting point, which is why the data from that study will be used. The relevant data for this thesis will be summarized in the section below. For more details on the data, the study of Przepiorka et al. (2017) can be consulted. It will be mentioned when additional changes are made to the data.

The original data set Christin (2013) collected contained 24,385 items. Because the research question in this study only focuses on the illegal drug market on Silk Road 1.0, the data set analysed is a subset of solely illegal drug items scraped from this cryptomarket. Przepiorka et al. (2017) establish seven categories of drugs to use in analyses, to make the calculation and comparability between items less complex, since those are sold in one form. The types of drugs that are utilized from the data set are weed, hash, cocaine, ketamine, MDMA, heroin and meth. Drug categories sold in multiple forms create variation in weight and substance, making the calculation and comparability harder to accomplish. This leads to 6,216 items included into the sample. Moreover, all items of which the weight was not disclosed were excluded, resulting in 5,675 items offered by 550 sellers (Przepiorka et al., 2017).

Lastly, Przepiorka et al. (2017) eliminated the items that received no feedback messages during the time of data collection. Because the number of feedback messages an item is used as a measure for the number of sales an item has gathered, there is no evidence that the listings without feedback messages generated any sales. Removing the items without any feedback messages from the subset produces a sample of 3,153 item listings, that all individually received at least one recorded sale. The remaining items were offered by 445 different sellers.

Variables and Model Estimations

As with the data explanation above, the variables and model estimations are replicated from the study of Przepiorka et al. (2017). The dependent variables of item price per gram (in USD) and item sales per day, the explanatory variables of positive and negative reputation scores and all control variables match the variables that were used by Przepiorka et al. (2017). First, the dependent and explanatory variables mentioned above will be set out. Second, an explanation will be provided of which explanatory variables are added and how these are implemented to the models to represent the self-advertisement and scammer forums. Lastly, the implementation of the control variables will be set forth.

The unit of analysis is an item offered by the seller. The two dependent variables are item price per gram (in USD) and number of item sales per day. Przepiorka et al. (2017) calculate item price per gram by dividing item price by item weight. Because no direct information on the number of sales per item is available from the data, the number of item sales is acquired from the total number of ratings a seller obtained for an individual item listing. A five-star rating is automatically awarded to a seller when a purchase is made, which therefore provides an accurate measure of the number of item sales. To determine the item sales per day, the number of item sales is divided by the amount of days the item was recorded to be online.

For the tests of Hypotheses 1 and 3, a regression model is implemented with the log-transformed item price per gram (in USD) as the dependent variable. The testing of Hypotheses 2 and 4 will be performed by a regression model with the log-transformed number of sales per day as a dependent variable. In all models, the same explanatory and control variables are used. However, Przepiorka et al. (2017) make two exceptions. In the model of item price the log number of total item sales is adopted as a measure for the quantity of an item a seller initially had in their possession. This is done because item prices are set by sellers. Since sellers are likely to give out quantity discounts to customers, the quantity of an item negatively affects the price of an item. For the model of sales per day, not the log number of item sales is used as an explanatory variable, but the log item price per gram since the first variable will negatively affect item price per day.

The independent variables implemented by Przepiorka et al. (2017) are sellers' positive reputation scores and negative reputation scores. The reputation scores are calculated by summing up all five-star and non-five-star ratings the seller has received by the time their item is first listed online. It should be remarked that the ratings are accumulated across all items of the seller. The items that are not included in the analyses are aggregated as well. This is done to create a reproduction of the aggregate reputation of a seller as it was displayed in Silk Road 1.0 as closely as possible. In the model, the log number of five-star ratings and as a

measure of positive seller reputation and the log number of non-five-star ratings as a measure of negative seller reputation. Five-star ratings account for 95.8 per cent of all ratings in the sample. Przepiorka et al. (2017) mention that non-five-star ratings are given in extraordinary cases and might have a negative impact on a seller's reputation irrespective of the actual number of stars.

Furthermore, two explanatory dummy variables are added to the regression models in parallel with the self-advertisement and scammer forum, that are not included in the models of Przepiorka et al. (2017). The first dummy variable is derived from the variable in the dataset that represents the number of forum posts placed by other members in a subforum for self-advertisement, discussing the seller. It is calculated by distinguishing whether a seller is mentioned or not in one or more of the posts that were placed by other members on threads in the "Product offers" subforum of Silk Road 1.0, up until the time the item was posted. The "Product offers" forum was set up to create an opportunity for sellers to offer their products to potential buyers. The members' posts are comments on threads opened by sellers for the promotion of their products. This dummy variable will henceforth be called the *self-advertisement forum variable*. The variable will be used in the analyses for Hypotheses 1 and 2, by adding it as an explanatory variable to the regression model, and for Hypotheses 5 and 6, as a moderation with the reputation scores. The second dummy variable is based on the variable that represents the number of forum posts placed by other members in the "Rumor mill" subforum, discussing the seller. This subforum was set up so that users would be able to discuss sellers, their products or other topics related to sellers on the cryptomarket. The variable is measured by computing all posts by other members that mention the seller on threads in this "Rumor mill", up until the time the item was posted on the cryptomarket. In this case, the threads are opened by other users, not the seller themselves. The dummy variable will henceforth be called the *scammer forum variable*. Like the variable described previously, this variable is implemented as an explanatory variable at first, for Hypotheses 3 and 4, and as a moderation variable combined with reputation scores afterwards, for Hypotheses 7 and 8.

In the models multiple control variables are used by Przepiorka et al. (2017), which are implemented in this study as well. The seven categories of illegal drugs, introduced in the data explanation section above, are pooled together into three price categories: low price (weed and hash), medium price (cocaine, ketamine, and MDMA) and high price (heroin and meth).

Table 1*Descriptive statistics of the main variables used for analysis*

Variable name	N	Mean	SD	Median	Minimum	Maximum
<i>Item sales and duration online</i>						
Number of item sales	3,153	20.73	58.95	5	1	1501
Item online sales	3,153	50.44	56.17	28	0.5	382
Number of it sales per day	3,153	0.45	0.69	0.25	0.01	10.83
<i>Seller ratings at time item was first seen</i>						
Number of five-star ratings	3,153	117.8	306.2	56	0	2600
Number of non-five-star ratings	3,153	6.807	17.05	1	0	148
<i>Seller mentioned in forum post</i>						
Self-advertisement forum	3,153	0.216	0.411	0	0	1
Scammer forum	3,153	0.231	0.422	0	0	1
<i>Low-price products (weed, hash)</i>						
Weight in grams	2,297	18.15	63.57	5	0.25	1000
Price in USD per gram	2,297	15.50	7.3	14.61	1.46	115.8
<i>Medium-price products (ketamine, MDMA, cocaine)</i>						
Weight in grams	562	7.17	45.00	1	0.05	1000
Price in USD per gram	562	92.26	57.52	80.58	8.41	464.13
<i>High-price products (meth, heroin)</i>						
Weight in grams	294	1.40	3.87	0.5	0.1	56
Price in USD per gram	294	217.55	140.40	173.81	33.72	992.8

Note: The data contain N=3,153 items which were online for 50 days and resulted in 21 sales on average. Only items that were registered to have at least one transaction are applied in this analysis (as described in ‘Data and Methods’). The seller of an item has 118 five-star and 7 non-five-star ratings on average. Per item the seller was discussed on the self-advertisement forum 5 times and 7 times on the scammer forum on average. Low-price items (N=973), comprising of weed and hash, are sold for 16 USD per gram in packages of 18 grams on average. Medium-price items (N=311), containing ketamine, MDMA and cocaine, are sold for 92 USD per gram in packages of 7 grams on average. High-price items (N=108), consisting of meth and heroin, are sold for 218 USD per gram in packages of 1 gram on average.

These pools are created to reduce the number of control variables. A set of three dummy variables are assembled in line with the price categories, with low price items as the reference category. Items are offered in quantities ranging from 0.05 g to 1,000 g (see Table 1). In the analyses, item weight is log-transformed, since a negative effect on item price because of quantity discounts offered by sellers is expected. Item weight will also have a negative effect on the number of sales per day because of a lower demand for bulk orders (Aldridge and Décary-Héту, as cited in Przepiorka et al., 2017). Furthermore, dummy variables are set up for shipping locations of each item listing that are offered by the sellers. Because sellers who ship their orders internationally face additional risks (Décary-Héту et al., as cited in Przepiorka et

al., 2017), these sellers could impose a price premium. Whether a seller ships solely domestically or internationally as well is determined by the information on their country of origin and the countries and region sellers ship to. Additionally, a distinction is made for sellers of whom the shipping locations are unknown. The dummy variable that represents the sellers who only ship domestically constitute the reference category. One dummy variable accounts for the poor quality, which is a comment that is sometimes mentioned in the titles of low price items. The last control variable is a dummy variable to mark items that were listed online on the last 2 days of data collection, since the data are right censored. Table 1 displays the descriptive statistics of the main variables used in the analyses.

Results

Table 2 presents the results of the first two regression models analysed. They show positive effects for the log number of five-star ratings and negative effects for the log number of non-five-star ratings, as expected. The reputation score coefficients in the models of Table 2 are all significant.

The estimates of the log of the self-advertisement forum variable in Models 1 and 2 indicate positive effects. Both coefficients of the self-advertisement variable in Table 2 are significant, which suggests that there is support for Hypotheses 1 and 2.

The log of the scammer forum variable in Table 2 suggests a negative effect towards item price per gram and a positive outcome for the number of item sales per day. The first effect follows the assumption of Hypothesis 3, while the second effect does not conform to Hypothesis 4. However, solely the positive effect of Model 4 shows significance, indicating that the effects of the scammer forum variable does not provide evidence for these hypotheses.

Most of the control variables in Table 2 display effects that are in line with the hypotheses. Item price per gram in the second model shows a significant negative effect, implying that the higher the price, the slower the speed at which items are sold. The significant negative effect of number of sales on item price indicates that higher weighing orders and a higher amount of sales creates a lower price, suggesting that sellers provide discounts for bulk orders. As expected, products in higher categories and of higher quality are offered for a higher price by sellers. Poor quality in products only has a significant negative effect on the item price. It does not seem to have a significant effect on the number of item sales per day. The control variable that differs from its assumption is that of the location that sellers ships to. While it was expected that sellers who also ship to foreign countries would

Table 2*Regression models of item price and sales per day with reputation scores and forum variables*

Variable name	Log(item price per gram in USD)	Log(number of item sales per day)
	<i>M1</i>	<i>M2</i>
Constant	3.000*** (0.017)	0.435** (0.165)
<i>Item variables</i>		
Log(item price per gram in USD)	-	-0.651*** (0.053)
Log(weight in grams)	-0.220*** (0.005)	-0.451*** (0.018)
Low price	(reference)	(reference)
Medium price	1.461*** (0.018)	0.914*** (0.095)
High price	2.149*** (0.025)	1.415*** (0.136)
Poor quality	-0.885*** (0.51)	-0.070 (0.160)
Last 2 days	0.053** (0.016)	0.058 (0.047)
<i>Seller variables</i>		
Log(number of five-star ratings + 1)	0.033*** (0.004)	0.172*** (0.013)
Log(number of non-five-star ratings + 1)	-0.040*** (0.008)	-0.237*** (0.023)
Self-advertisement forum variable	0.046** (0.017)	0.109* (0.050)
Scammer forum variable	-0.004 (0.017)	0.201*** (0.050)
Log(number of sales)	-0.018*** (0.005)	-
Seller ships to		
Unknown	0.000 (0.031)	-0.327*** (0.092)
Domestic only	(reference)	(reference)
Foreign	-0.089*** (0.014)	0.001 (0.041)
<i>N1</i>	3,153	3,153
<i>N2</i>	445	445
<i>Adjusted R²</i>	0.883	0.221

Note: ***P < 0.001, **P < 0.01, *P < 0.05, with two-sided tests. N1 represents the number of item listings. N2 represents the number of sellers.

charge a higher price, the only significant effect that can be observed is the negative effect on the item price. Although the explanation is unclear, when the shipping location of a seller is unknown, the results show a significant negative effect on the number of item sales per day.

The coefficient estimates of the reputation scores in Table 3 show similar results to those in Table 2. Models 3 and 4 both reveal positive effects for the log of the number of five-star ratings and negative effects for the log of the number of non-five-star ratings. These effects are all significant as well.

Table 3*Regression models of item price and sales per day with reputation scores and forum variables*

Variable name	Log(item price per gram in USD)	Log(number of item sales per day)
	M3	M4
Constant	2.993*** (0.018)	0.440** (0.166)
<i>Item variables</i>		
Log(item price per gram in USD)	-	-0.647*** (0.053)
Log(weight in grams)	-0.220*** (0.005)	-0.450*** (0.018)
Low price	(reference)	(reference)
Medium price	1.460*** (0.018)	0.901*** (0.095)
High price	2.156*** (0.025)	1.389*** (0.136)
Poor quality	-0.889*** (0.51)	-0.075 (0.160)
Last 2 days	0.056*** (0.016)	0.057 (0.047)
<i>Seller variables</i>		
Log(number of five-star ratings + 1)	0.031*** (0.005)	0.175*** (0.014)
Log(number of non-five-star ratings + 1)	-0.031*** (0.009)	-0.261*** (0.026)
Self-advertisement forum variable	0.122*** (0.035)	0.161 (0.104)
Scammer forum variable	-0.067 (0.040)	0.029 (0.120)
Log(number of five-star ratings + 1) * Self-advertisement forum variable	-0.018 (0.012)	-0.013 (0.035)
Log(number of non-five-star ratings + 1) * Self-advertisement forum variable	-0.008 (0.022)	-0.038 (0.066)
Log(number of five-star ratings +1) * Scammer forum variable	0.031* (0.012)	-0.005 (0.037)
Log(number of non-five-star ratings + 1) * Scammer forum variable	-0.051* (0.023)	0.188** (0.070)
Log(number of sales)	-0.020*** (0.005)	-
<i>Seller ships to</i>		
Unknown	0.000 (0.031)	-0.313** (0.092)
Domestic only	(reference)	(reference)
Foreign	-0.084*** (0.014)	0.008 (0.042)
<i>N1</i>	3,153	3,153
<i>N2</i>	445	445
<i>Adjusted R²</i>	0.884	0.224

Note: ***P < 0.001, **P < 0.01, *P < 0.05, with two-sided tests. N1 represents the number of item listings. N2 represents the number of sellers.

As for the main forum variables, only one significant effect can be detected in Table 3. This can be found in Model 3, where the self-advertisement variable presents a positive effect on the item price per gram, which is in line with Hypothesis 1. All other coefficients representing

the self-advertisement and scammer forums do not produce any significant effects, which subsequently does not provide any evidence for Hypotheses 2 through 4. The interactions between the reputation scores and the scammer forum variables on price per gram are both significant, where the moderation of this forum variable with five-star ratings provides a positive effect, confirming Hypothesis 1, and a negative effect for the interaction in combination with the non-five-star ratings, not matching Hypothesis 1. The only interaction on number of sales that is significant is the positive effect between the non-five-star ratings and the scammer forum, which does not follow the expectations of Hypotheses 3 and 4. None of the interaction effects relating to the self-advertisement forum are significant and neither is the effect between the scammer forum and five-star ratings. Despite the significant interaction coefficients the significance of reputation scores on item price per gram and the number of items sold per day did not decrease. As mentioned before, the coefficients of the logged number of five-star ratings maintain a positive effect, while the non-five-star ratings remain negative. These results are not in line with Hypotheses 5 through 8, which assume that the absolute effect of the reputation scores would decrease due to the interactions between ratings and forums.

The control variables in Table 3 match the coefficient estimates of Table 2 in slope and significance. The log item price per gram in Model 4 and log weight in grams in both show negative significant effects. The log of the number of sales has a negative effect on item price per gram, which is also significant. The expectation that sellers increase the prices they charge in higher price categories applies in the last two models as well. Like can be seen in Table 2, Table 3 only exhibits a significant effect of poor quality on item price per gram in Model 3, which is negative as expected. Model 4 presents a negative effect of poor quality as well, but the effect on the number of item sales per day is not significant here either. Shipping to foreign countries has a significant negative effect on item price per gram, which is against expectations, matching Table 2. When the shipping location is unknown, it has a significant negative effect on the number of item sales per day, which was not assumed either.

Conclusion & Discussion

In this thesis the cooperation between anonymous sellers and buyers on cryptomarkets is studied. Data collected from the first large-scale cryptomarket, Silk Road 1.0, is used to test the influence of contact on forums between sellers and buyers on the reputation of vendors, the prices that are charged for products and how quickly these products are sold. The kinds of forums that are taken into account are a self-advertisement forum, where sellers are able to

present their products to customers, and a scammer forum, where sellers, their products and other topics related to sellers are discussed. In both cases the distinction is made whether sellers are mentioned by other members of the cryptomarket on either of the forums or not.

Przepiorka et al. (2017) conclude in their study that reputation scores have an effect on prices charged and the amount of sales made by sellers. In this thesis it is tested whether communication on forums influences the effect of seller reputation.

I find that in the case a seller has been mentioned on the self-advertisement forum, the product price per gram and the number of item sales per day increase. By contrast, if a vendor is mentioned by others on the scammer forum the item price per gram and the amount of daily item sold decline. Evidence is found to conclude that the mentioning of a seller on a self-advertisement forum raises the price of products and the amount of products that are sold per day. If a seller is mentioned on a scammer forum, I find that this only has an increasing effect on the number of sales and not on the product price. The mentioning of sellers by members of the cryptomarket on the self-advertisement and the scammer forums does not seem to have an influence on the effect of reputation scores on prices and sales when to results are considered.

Bearing this conclusion in mind, the importance of reputation systems managed by cryptomarkets (Przepiorka et al. 2017; Jiao et al. 2021) is emphasized. Self-advertisement and scammer forums do not seem to have the effect that feedback ratings have on the pricing and sales of illicit goods. The effect of signals that are derived from sellers' reputation are not weakened by the signals acquired from these forums (Gambetta, 2009; Przepiorka and Berger, 2017; Norbutas, 2020).

Future research could be focused on the contents and influence of the "Rumor mill" forum (scammer forum) on Silk Road, as the results in relation to the scammer forum were not in line with expectations. This element simultaneously is an aspect that could be improved upon in this thesis. The fact that the 'scammer forum' is used to discuss sellers, their products and subjects related to them does not mean that the contents of this forum are all negative experiences in connection to a seller. Positive experiences and recommendations could be shared as well, which could possibly explain why the results show that vendors sell more items per day when they are mentioned on the scammer forum.

Moreover, it should be noted that the data used in this study is obtained from the first cryptomarket that became popular among users (Martin, 2014). Researching other cryptomarkets that operated more recently could gain even more knowledge into the roles that reputation and forums play in cryptomarkets. Comparing data from Silk Road 1.0 and other cryptomarkets would produce more insight whether sellers' reputation and forum mentions

have sustained their effect on illicit online markets or if the importance of these aspects have developed differently more modern cryptomarkets.

Literature

- Aldridge, J. & Décary-Héту, D. (2014). Not an 'Ebay for Drugs': The Cryptomarket 'Silk Road' as a Paradigm Shifting Criminal Innovation. Retrieved from Social Science Research Network: <http://ssrn.com/abstract=2436643>
- Bancroft, A. & Scott Reid, P. (2017). Challenging the techno-politics of anonymity: the case of cryptomarket users. *Information, Communication and Society*, 20(4), 497-512.
- Branwen, G., Christin, N., Décary-Héту, D., Munksgaard Andersen, R., StExo, El Presidente, Anonymous, Lau, D., Sohlhlz, Kratunov, D., Cakic, V., Van Buskirk, Whom, McKenna, M. & Goode, S. (2015). Dark Net Market archives, 2011–2015. Retrieved from <https://www.gwern.net>
- Christin, N. (2013). Traveling the Silk Road: A measurement analysis of a large anonymous online marketplace. arXiv, 1207.7139.
- Décary-Héту, D., Paquet-Clouston, M. & Aldridge, J. (2016). Going international? Risk taking by cryptomarket drug vendors. *International Journal of Drug Policy*, 35, 69-76.
- Dellarocas, C. (2003). The digitization of word of mouth: promise and challenges of online feedback mechanisms. *Management Science*, 49(10), 1407-1424.
- Diekmann, A., Jann, B., Przepiorka, W. & Wehrli, S. (2014). Reputation formation and the evolution of cooperation in anonymous online markets. *American Sociological Review*, 79(1), 65-85.
- Gambetta, D. (2009). Signaling. In Hedström, P. & Bearman, P. (eds), *The Oxford Handbook in Analytical Sociology*. Oxford: Oxford University Press, pp. 168-194.
- Hardy, R. A. & Norgaard, J. R. (2016). Reputation in the Internet black market: an empirical and theoretical analysis of the Deep Web. *Journal of Institutional Economics*, 12, 515-539.
- Jiao, R., Przepiorka, W. & Buskens, V. (2021). Reputation effects in peer-to-peer online markets: A meta-analysis. *Social Science Research*, 95, <https://doi.org/10.1016/j.ssresearch.2020.102522>
- Jin, G.Z. & Kato, A. (2006). Price, quality and reputation: evidence from an online field experiment. *The RAND Journal of Economics*. 37(4), 983-1005.
- Martin, J. (2014). Lost on the 'Silk Road': Online drug distribution and the 'cryptomarket'. *Criminology & Criminal Justice*, 14(3), 351-367.
- Martin, J., Cuncliffe, J. & Munksgaard, R. (2019). *Cryptomarkets: a Research Companion*. Bingley, United Kingdom: Emerald Publishing.
- Moeller, K., Munksgaard, R. & Demant, J. (2017). Flow my FE the vendor said: Exploring

- violent and fraudulent resource exchanges on cryptomarkets for illicit drugs. *American Behavioral Scientist*, 61(11), 1427-1450.
- Morelato, M., Broseus, J., De Grazia, A., Tahtouh, M., Esseiva, P. & Roux, C. (2018). Forensic drug intelligence and the rise of cryptomarkets. Part II: Combination of data from the physical and virtual markets. *Forensic Science International*, 288, 201-210
<https://doi.org/10.1016/j.forsciint.2018.05.002>
- Norbutas, Lukas. (2020). TRUST ON THE DARK WEB: An Analysis of Illegal Online Drug Markets. ICS-dissertation, Utrecht. [Chapter 5]
- Ormsby, E. (2014). *Silk Road*. Victoria, Australia: Palgrave Macmillan.
- Przepiorka, W. (2013). Buyers pay for and sellers in a good reputation: more evidence from eBay. *Journal of Socio-Economics*, 42, 31-42.
- Przepiorak, W. & Berger, J. (2017). Signaling theory evolving: signals and signs of trustworthiness in social exchange. In B. Jann and W. Przepiorka (Eds.), *Social Dilemmas, Institutions and the Evolution of Cooperation* (pp. 373-392). Berlin, Germany: De Gruyter Oldenbourg.
- Przepiorka, W., Norbutas, L., & Corten, R. (2017). 'Order without law: Reputation promotes cooperation in a cryptomarket for illegal drugs', *European Sociological Review*, 33(6), 752- 764
- Raub, W. (2004). Hostage Posting as a mechanism of trust: binding, compensation, and signaling. *Rationality and Society*, 16(3), 319-365.
- Resnick, P. & Zeckhauser, R. (2002). Trust Among Strangers in Internet Transactions: Empirical Analysis of eBay's Reputation System. In M.R. Baye (Ed.), *The Economics of the Internet and E-Commerce (Advances in Applied Microeconomics, Vol. 11)* (pp. 127-157). Stamford CT: JAI Press.
- Sears, J.M. (2016). *A Reputation for the Good Stuff: User Feedback Signaling and the Deep Web Market Silk Road* (Doctoral Dissertation, Montana State University)
- Zającz, R. (2017). Silk Road: The market beyond the reach of the state. *The Information Society*, 33(1), 23-34.